Number 149

AGS STUDIES REPORT

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Subject AGS Horizontal and Vertical Emittance vs Energy

OBSERVATIONS AND CONCLUSION

The Ionization Profile Monitor (IPM) has been used extensively to study the horizontal and vertical beam size vs energy in the AGS. Typical results from early in the present running cycle are reported here. Measurements were made both in normal operation at high intensity (10×10^{12} protons per pulse) and in a studies run at low intensity (2.5×10^{12}). Report BNL-32007 describes the method used to calculate the beam size (standard deviation) and the corresponding normalized emittance at each energy. For the horizointal measurements, a correction for momentum spread is made, based on measured longitudinal parameters. This correction is given in Eq. (3) of the report.

The measured horizontal normalized emittances (Figures 1 and 2) show a substantailly constant value throughout the acceleration cycle, as was already discussed in BNL-32007. There is some variation at the beginning of the acceleration cycle, and some fluctuation around transition, where the momentum spread correction is large. Nonetheless the agreement with adiabatic shrinkage is impressive.

With the installation of the second IPM unit, vertical data have become available (Figures 3 and 4). The surprising feature is that, unlike the horizontal case, the agreement with adiabatic shrinkage is poor. The beam does not shrink as fast as it should, and so the normalized emittance grows with energy. This growth is observed both at high and at low intensity.

An alternative way to view the rsults is to look at the measured beam sizes vs energy (Figures 5-8). Here the measured sizes (points) are compared with curves showing what is expected for constant normalized emittance. Figures 5 and 6 show quite clearly that there is good agreement with constant normalized emittance in the horizontal plane. Figures 7 and 8 show that the vertical size fails to shrink as fast as expected for constant normalized emittance.

Two areas for future investigation are suggested. First, it should be possible by improving the transverse matching at injection to achieve smaller emittancs than reported here. Second, the cause of the vertical emittance growth needs to be determined.

NORMALIZED HORIZONTAL EMITTANCE vs TIME

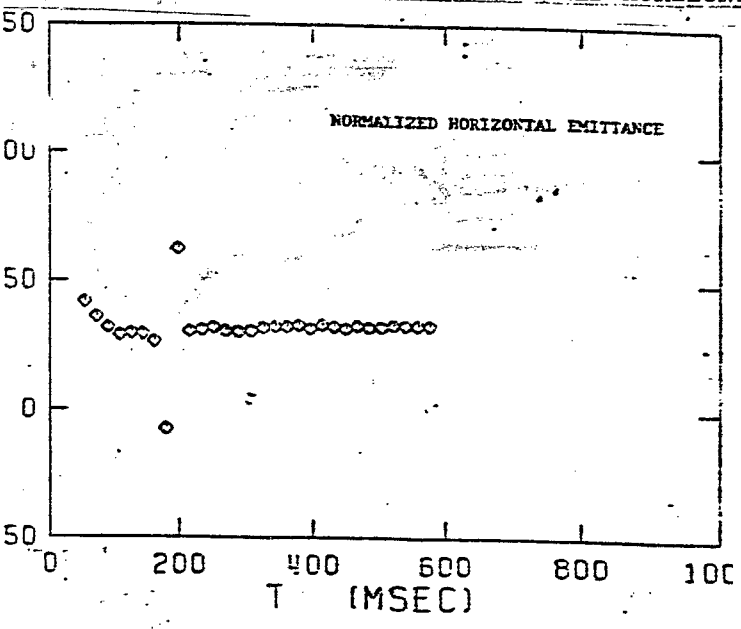

Figure 1 - LOW INTENSITY

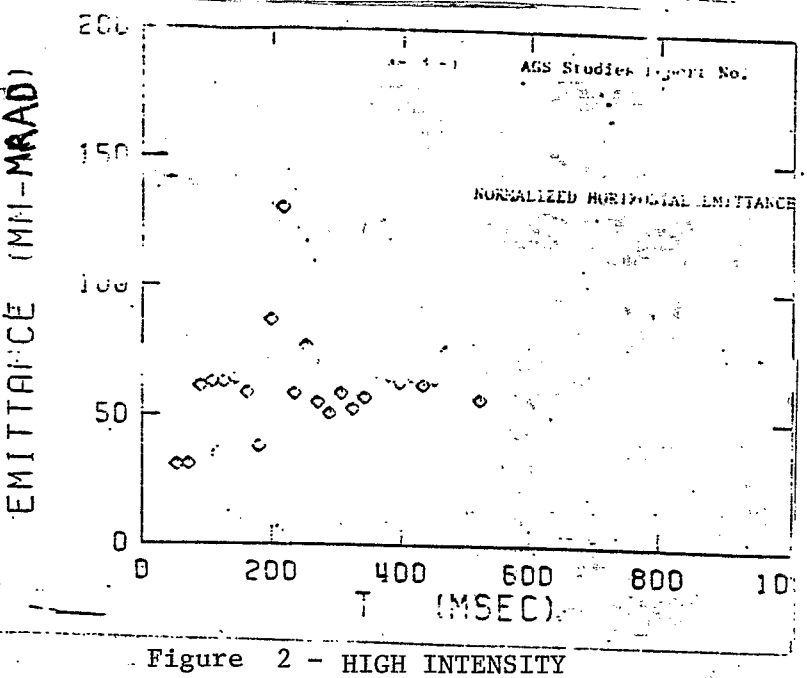

Figure 2 - HIGH INTENSITY

NORMALIZED VERTICAL EMITTANCE vs TIME

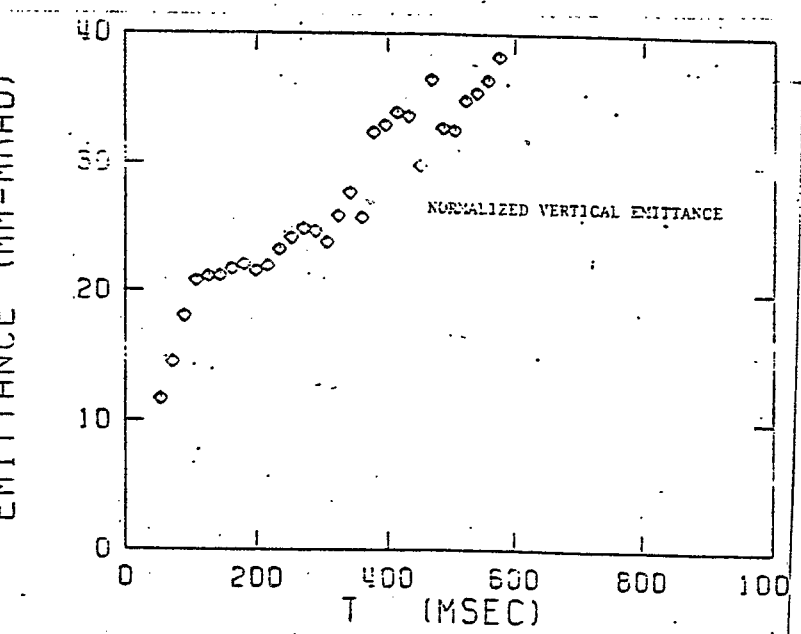

Figure 3 - LOW INTENSITY

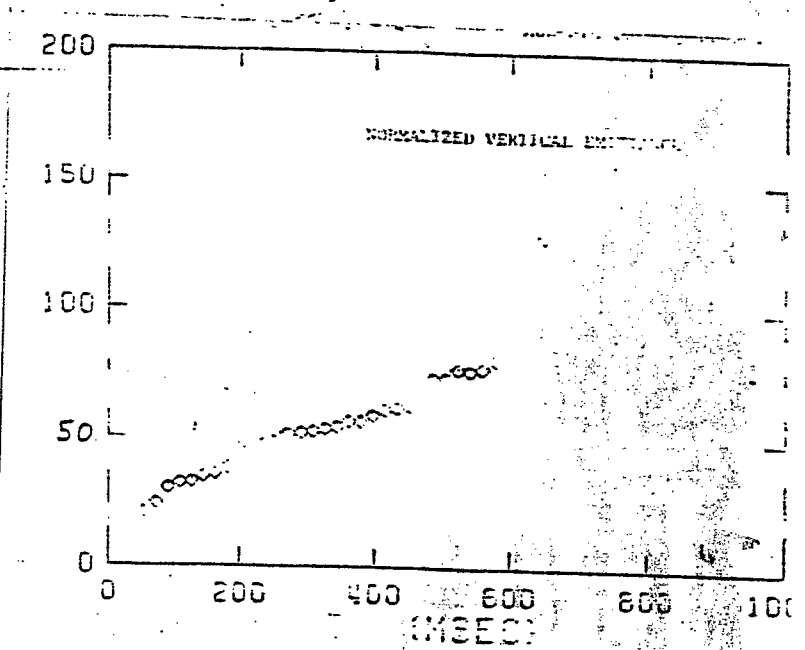

Figure 4 - HIGH INTENSITY

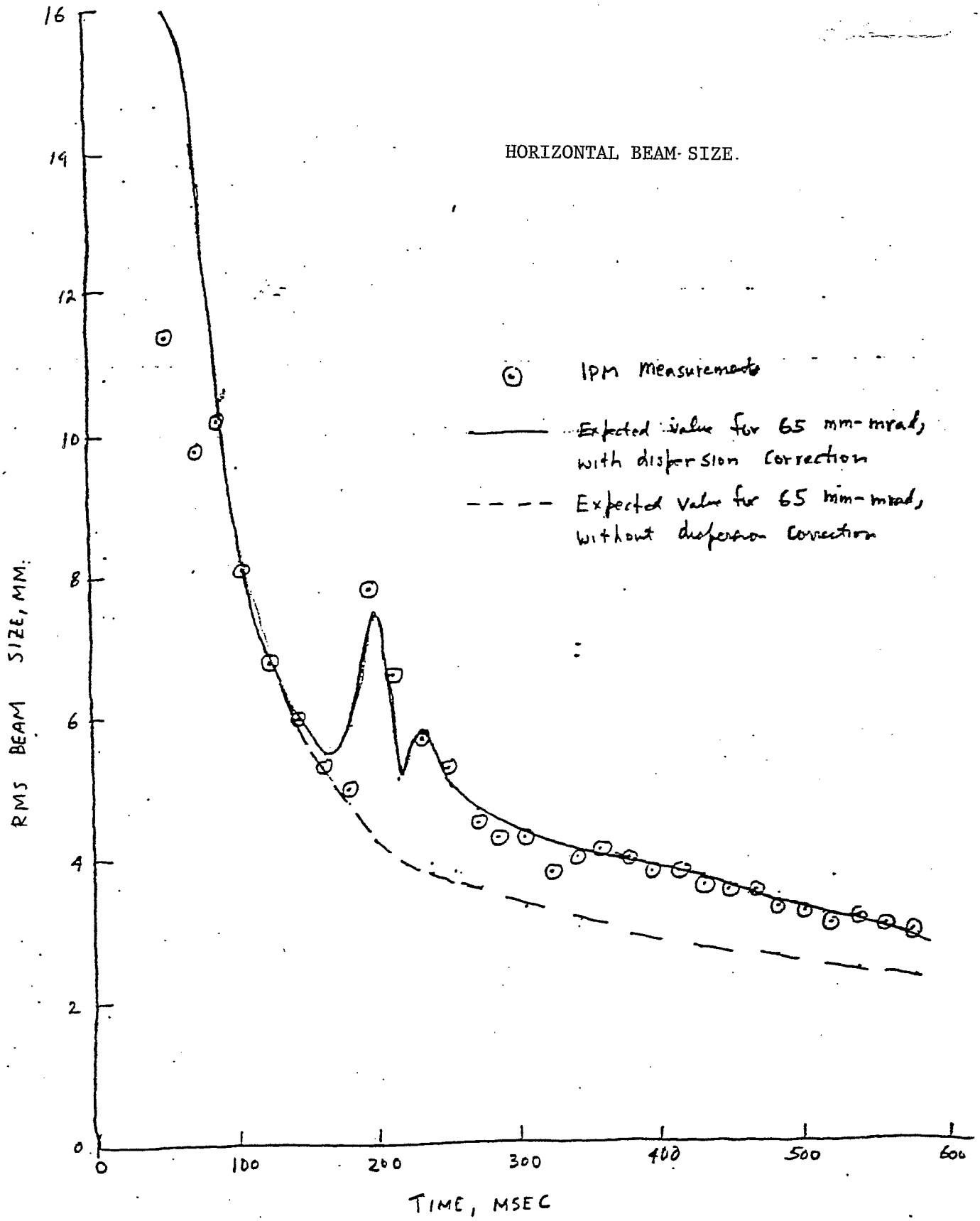

FIGURE 5 - Horizontal beam size vs time in accelerating cycle for high intensity.

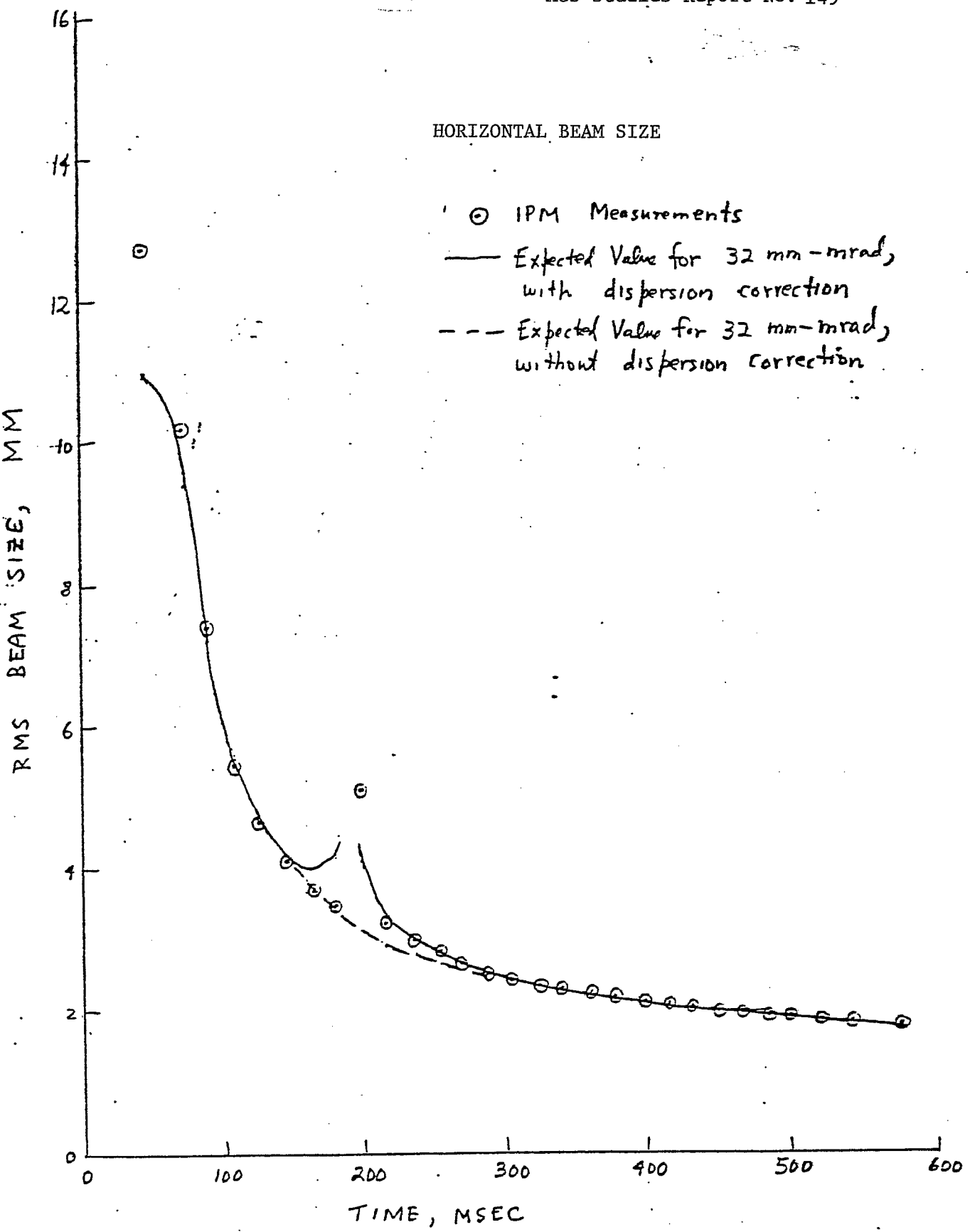

FIGURE 6 - Horizontal beam size vs time in accelerating cycle for low intensity.

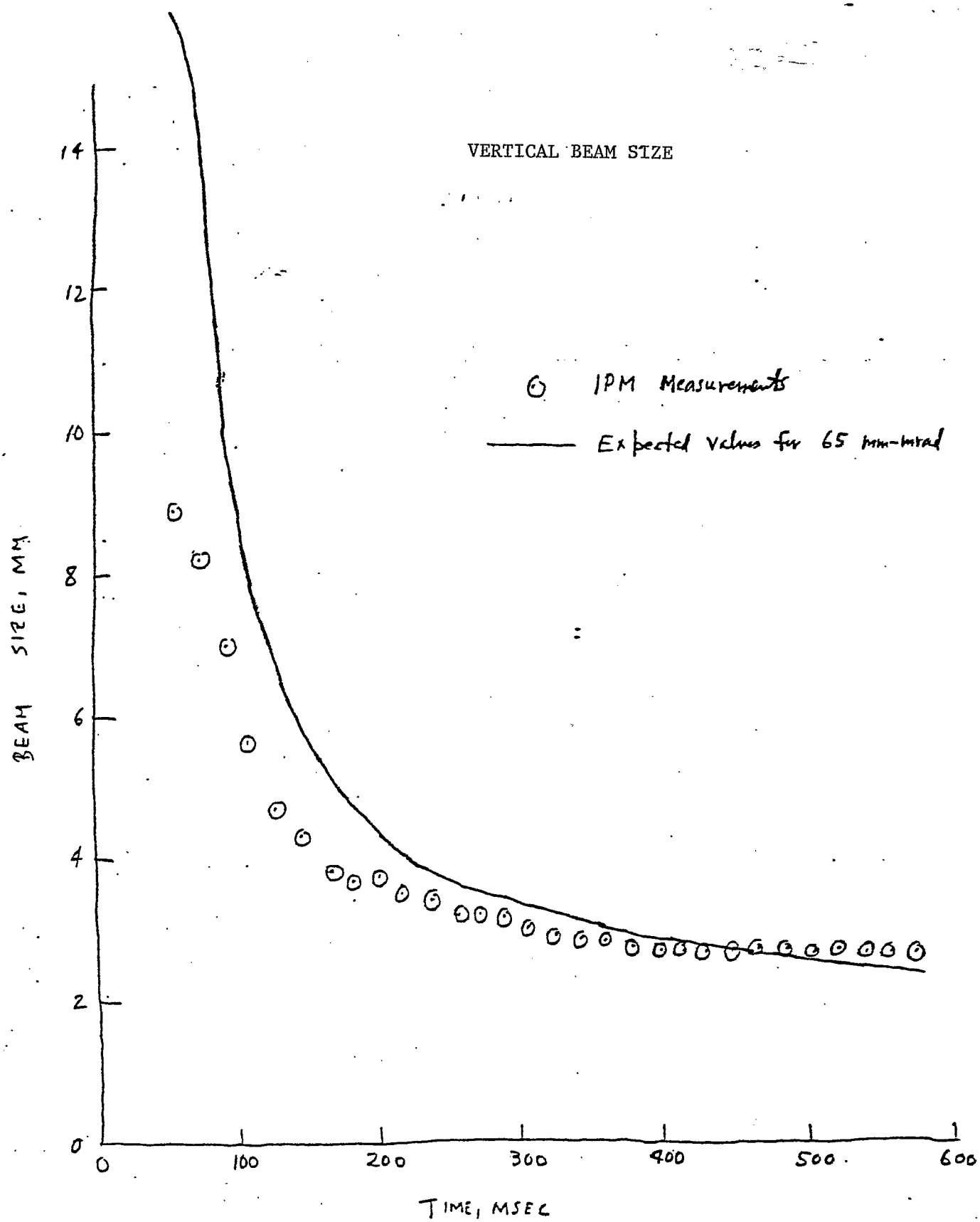

FIGURE 7 - Vertical beam size vs time in accelerating cycle for high intensity.

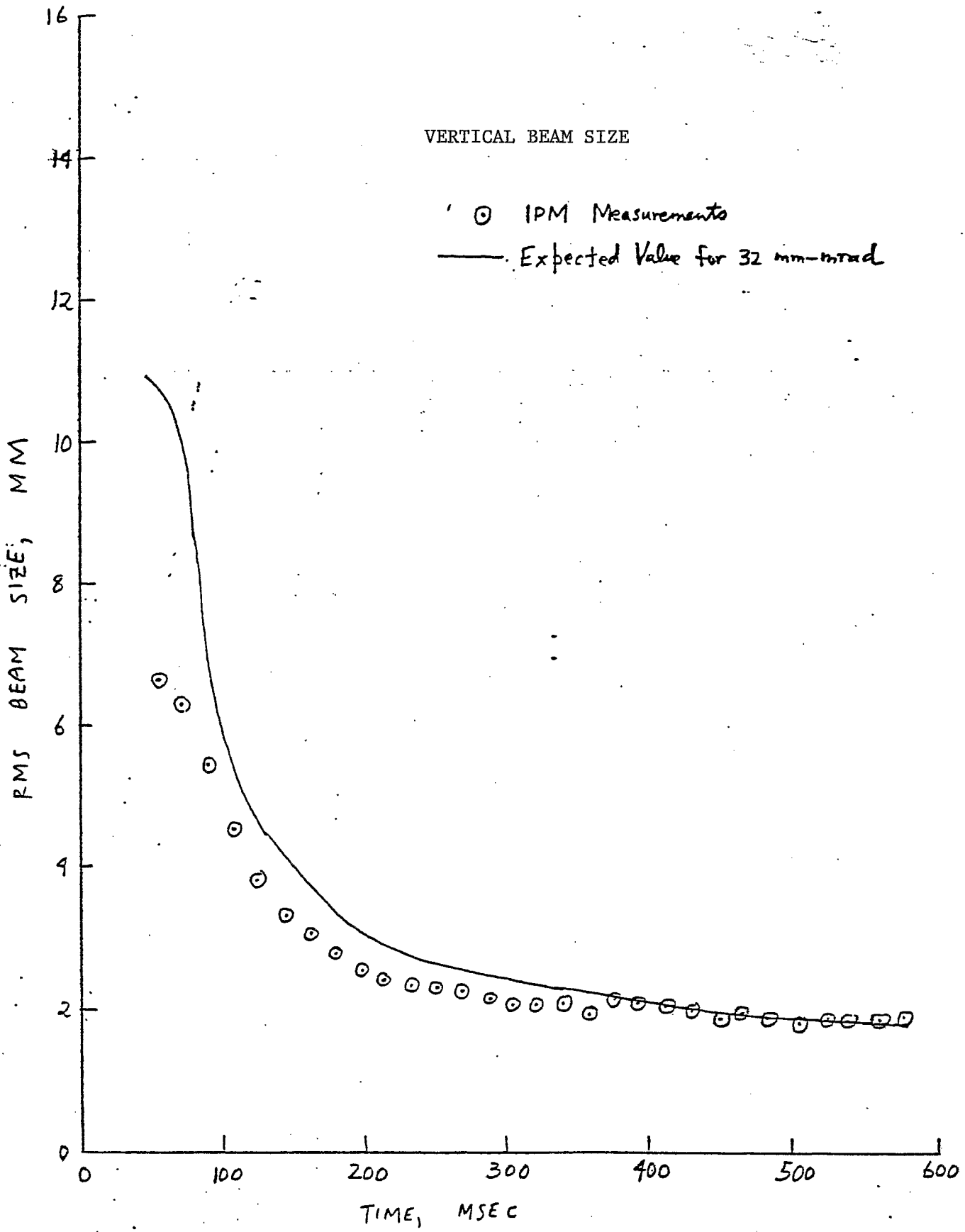

FIGURE 8 - Vertical beam size vs time in accelerating cycle for low intensity.